

Early School Progress in Children with Extreme Prematurity

Improvements in neonatal intensive care have led to the increasing survival of children born with extreme prematurity. These children typically suffer from a range of neurodevelopmental and health problems that affect a variety of aspects of their lives, including their academic abilities. Extreme prematurity is defined as being born at less than 28 weeks gestational age and/or having a birth weight of less than 1000 grams. Of all premature or low birth weight children (birth weight <2500g, <37 weeks gestational age), these children are at highest risk for health, developmental, behavioral and other problems. These risks include serious medical concerns such as cerebral palsy, sensory deficits, motor impairment, global mental deficiency as well as cognitive impairment, behavioral problems, and deficits in academic achievement.¹

The health and neurodevelopmental effects of prematurity and low birth weight begin to show early in life. Young children born at low birth weight demonstrate poorer mental, motor, language, attentional, communicative and social skills when compared with children born at a normal birth weight.² Children with extreme prematurity represent the tiniest surviving infants and are at higher risk of impairments and other problems. For example, children with extreme prematurity are two to three times more likely to suffer from neurodevelopmental disorders than term-born normal birth weight children.³ Children with extreme prematurity are especially likely to suffer

from deficits in executive functioning, a set of abilities with implications for behavior and academic achievement. Executive functioning is broadly defined as those cognitive abilities necessary for goal-directed behaviors. Damage to the brain as a consequence of extreme prematurity impacts executive functioning, but more research is necessary to understand the implications of these deficits for learning and behavior at school entry.

Little is known about the problems children with extreme prematurity face at school entry. Research demonstrates that as birth weight decreases, rates of grade failure, placement in special educational interventions and classification as handicapped increases.⁴ Learning problems are not necessarily identified at early ages, and may not be diagnosed until a child has been in school for several years.⁵ Some of these issues may not be immediately or easily identifiable, but still have serious implications for children, particularly for future academic success. As a result, early identification and treatment of cognitive or behavioral issues is important for children with extreme prematurity.

Early problems in academic achievement are of particular concern because they have implications for later academic success, with consequences for children, their families, and society. Early studies of very premature or low birth weight infants tended to focus on survival and discharge from the hospital as a measure of success, but increasingly, researchers

recognize the importance of the long-term outcomes of extreme prematurity and low birth weight.⁶ There is evidence that some consequences of extreme prematurity worsen with age, and that learning problems at early ages predict academic problems later in life.⁷ Of the few studies which have been conducted on the outcomes of premature birth or low birth weight in adolescence and adulthood, some have found higher rates of medical, functional and neurodevelopmental problems than among normal birth weight cohorts, while others have found that infants born with extreme prematurity were functional as adults, suggesting that problems resulting from prematurity and low birth weight can be overcome in some cases.^{8,9}

Early recognition of academic issues and timely educational interventions are necessary to facilitate success for these children. By the time they enter kindergarten, children with extreme prematurity have begun to demonstrate educational and cognitive deficits. However, research has often focused on early outcomes as opposed to studying children at the time of school entry. In addition, few studies focus specifically on extremely premature children, who are at higher risk for negative outcomes. Research conducted by scholars at CWRU and colleagues seeks to bridge these gaps by identifying and addressing early academic consequences of extreme prematurity.



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Dr. Taylor and colleagues sought to compare the early learning progress of children with extreme prematurity with normal birth weight children. Their research investigated the type and extent of educational issues among children with extreme prematurity during their first year of kindergarten. The researchers then followed these children for their first three years of school, to document the cohort's issues and progress in their early education. Broadly, Dr. Taylor and colleagues sought to understand what problems children with extreme prematurity have when they begin school, whether or not these problems continue, and what educational interventions children were accessing. The project also investigates the environmental and social factors that promote or impede educational and developmental progress. This research is unique because of its focus on children at the time of school entry and because of the multiple methods and assessments used to gain a wide range of information about the needs, challenges and abilities of children with extreme prematurity.

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Methodology

The study sample consisted of 148 children with extreme prematurity who had been treated at the neonatal intensive care unit of Rainbow Babies and Children's Hospital in Cleveland, Ohio from 2001-2003 and who were recruited for the study during their initial year in kindergarten. Children with congenital infections or abnormalities were excluded. These children were compared to a control group of 111 children with normal birth weight and when possible (93 cases), the control group children were recruited from the same classrooms as the children with extreme prematurity. Of the children with extreme prematurity, 129 were in regular kindergarten classrooms, while 16 were in special education programs and three were home-schooled. The children with normal birth weight and those with extreme prematurity were similar in terms of sex, ethnicity and socioeconomic status.

Children, parents and teachers participated in the study. In a single session at the study office, parents completed interviews and questionnaires about their child and family, while the child took a variety of tests of academic achievement and IQ. Teachers of the children who attended regular classrooms completed ratings of student learning progress and identified if the children received any type of special education program or classroom accommodations. Classroom observations were also conducted. These procedures were then repeated once per year for the next two years in order to follow and better understand the child's progress in the early grades of school.

Study Findings

Children with extreme prematurity were older at school entry than the control group and were more likely to have been held back a year. They tended to be smaller in size and to have more respiratory problems than the children in the control group. The children who had been born extremely premature demonstrated a number of issues related to cognitive and academic abilities as well as behavioral problems. These difficulties were reflected in lower scores on tests of IQ and academic abilities compared to their class peers and lower ratings of learning progress from teachers. Areas of particular concern were language, problem-solving, and mathematics. Children with extreme prematurity tended to have the most problems with mathematics. Certain risk factors were associated with poor academic abilities, including lower socioeconomic status, neurodevelopmental impairment in early childhood and neonatal risk factors such as abnormal cranial ultrasounds, bronchopulmonary dysplasia, and neonatal infection. Behavioral issues included reported behavioral problems, more symptoms of ADHD and problems with executive functioning.

Teachers reported that children with extreme prematurity required more of certain types of classroom accommodation than children with normal birth weight, including more assistance from an adult, individualized teaching or modified instruction, alternative testing, and other classroom modifications. However, the results also demonstrated that not all children who were having problems with learning progress were receiving special education assistance.

In the study, 83% of the children had been enrolled in early intervention (EI) programs before beginning school. These children are known to be at high-risk from birth, and as a result, most receive some type of EI services. Problems in learning, behavior and cognition were evident in this group despite the receipt of these services, suggesting that EI services could be strengthened to support school readiness.

¹ Marlow N, Hennessy EM, Bracewell MA, Wolke D. Motor and executive function at 6 years of age after extremely preterm birth. *Pediatrics*. 2007; 120:793-804.

² Hack M, Klein NK, Taylor HG. Long-term developmental outcomes of low birth weight infants. *The Future of Children*. 1995; 15:176-196.

³ Taylor HG, Klein N, Drotar D, Schluchter M, Hack M. Consequences and risks for <1000-g birth weight for neuropsychological skills, achievement, and adaptive functioning. *Journal of Developmental and Behavioral Pediatrics*. 2006; 27:459-469.

⁴ Klebanov PK, Brooks-Gunn J, McCormick MC. School achievement and failure in very low birth weight children. *Journal of Developmental and Behavioral Pediatrics*. 1994; 15: 248-256.

⁵ Avchen RN, Scot KG, Mason CA. Birth weight and school-age disabilities: A population-based study. *American Journal of Epidemiology*. 2001; 154:895-901.

⁶ Vohr BR. How should we report early childhood outcomes of very low birth weight infants? *Seminars in Fetal and Neonatal Medicine*. 2007; 12:355-362.

⁷ Duncan GJ et al. School readiness and later achievement. *Developmental Psychology*. 2007; 43:1428-1446.

⁸ Eichenwald EC, Stark AR. Management and outcomes of very low birth weight. *The New England Journal of Medicine*. 2008; 358:1700-1711.

⁹ Saigal S et al. Transition of extremely low-birth-weight infants from adolescence to young adulthood. *The Journal of the American Medical Association*. 2006; 295:667-675.

Implications for Policy and Practice

The research by Dr. Taylor and his colleagues is among the first to consider the issues of extremely premature children at school entry and to also consider their participation in educational interventions. It demonstrates that, although children with extreme prematurity are receiving more educational interventions than children with normal birth weight, they are not receiving all the services necessary to improve their likelihood of academic success. The research further shows that children already suffer from cognitive, behavioral and academic issues at the time that they enter school, thereby making a case for early intervention, particularly during the pre-school years, and transition services among this group.

Academic problems in early education have implications for a child's academic career and life more generally. Dr. Taylor and colleagues' research shows that among this group of children born at the limits of viability, early insults to the brain have implications for a child's development and academic success. While this study documents higher rates of learning problems among children with extreme prematurity, more research is necessary to uncover factors that contribute to, or ameliorate, these problems.

Although cognitive and developmental delays are generally identified early in extremely premature children through EI

supports, learning and behavioral problems associated with extreme prematurity are not always identified until after school entry, causing a delay in the provision of educational and developmental interventions that could assist children with extreme prematurity. The work of Dr. Taylor and colleagues demonstrates that teachers are aware of children's issues, whether or not they are receiving accommodations. As such, teachers are a resource for the earlier identification of learning problems among these children. Early identification of behavioral, cognitive and academic problems can, if followed by appropriate interventions, lead to a reduction in the long-term educational and social costs of extreme prematurity. Early identification and support services should not focus only on identifying problems at the level of the child, but also must take into account the multiple social and environmental factors that influence children's development and education.

While more children who are born extremely premature are surviving to school age, they nonetheless carry a burden of morbidities that have implications for their academic success and quality of life. Since children with extreme prematurity are known to be vulnerable, many are enrolled in EI programs. However, not all children are receiving these programs, especially as they transition to pre-school age, and those who

do receive interventions often still show disadvantages when compared with children born at normal birth weight. Once they enter school, not all children with extreme prematurity who suffer from learning problems receive educational interventions to minimize the negative implications of extreme prematurity. For those children who do receive interventions, it is not clear if these interventions are most effectively addressing those areas where children need most assistance, such as mathematics and executive functioning. In addition, this study, which looked at children at the age of school-entry, demonstrated that educational problems are already apparent by the time a child enters kindergarten, suggesting that early intervention programs could target specific areas associated with school readiness. This research demonstrates the need for promoting policies that strengthen coordinated care from birth until school entry in order to maximize school readiness and to provide children with interventions that address their individual pattern of cognitive-behavioral strengths and weaknesses. For this reason, children with extreme prematurity may need earlier and more extensive developmental and educational interventions to help counter the effects of extreme prematurity on academic success. Further research on the kinds of early interventions that most effectively address these concerns would be beneficial.

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